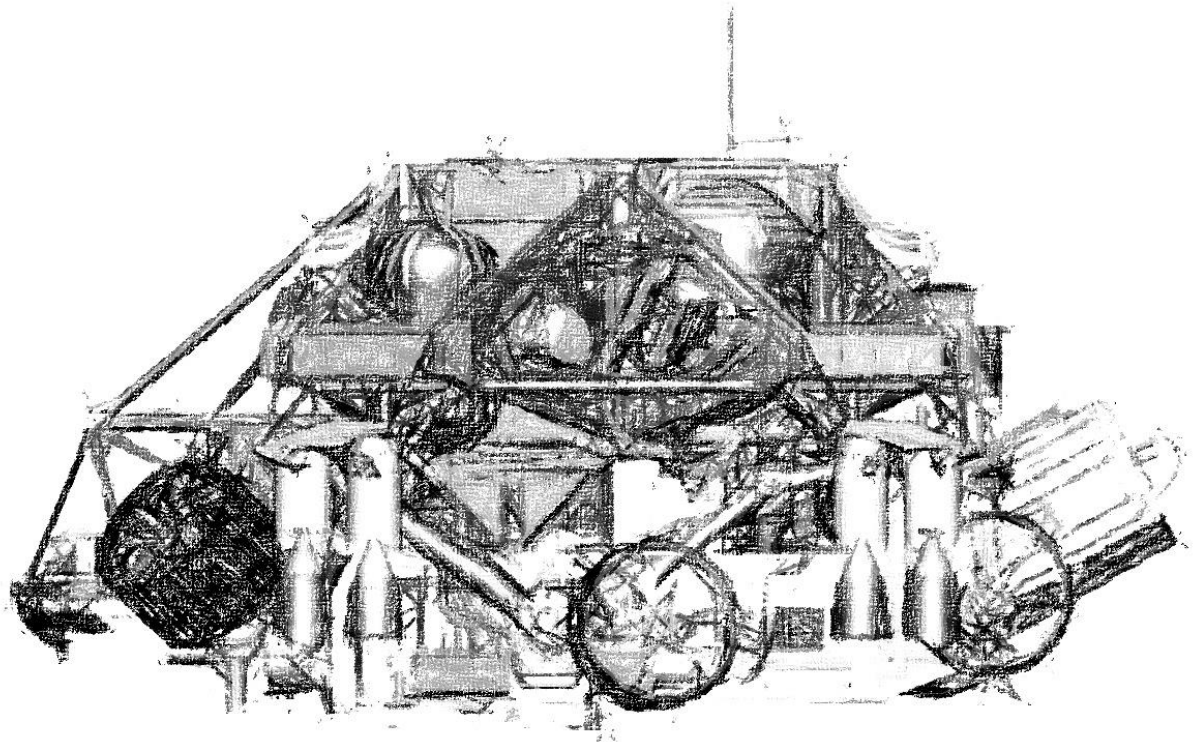


Flight System Verification & Validation

Mars 2020 Entry, Descent, and Landing

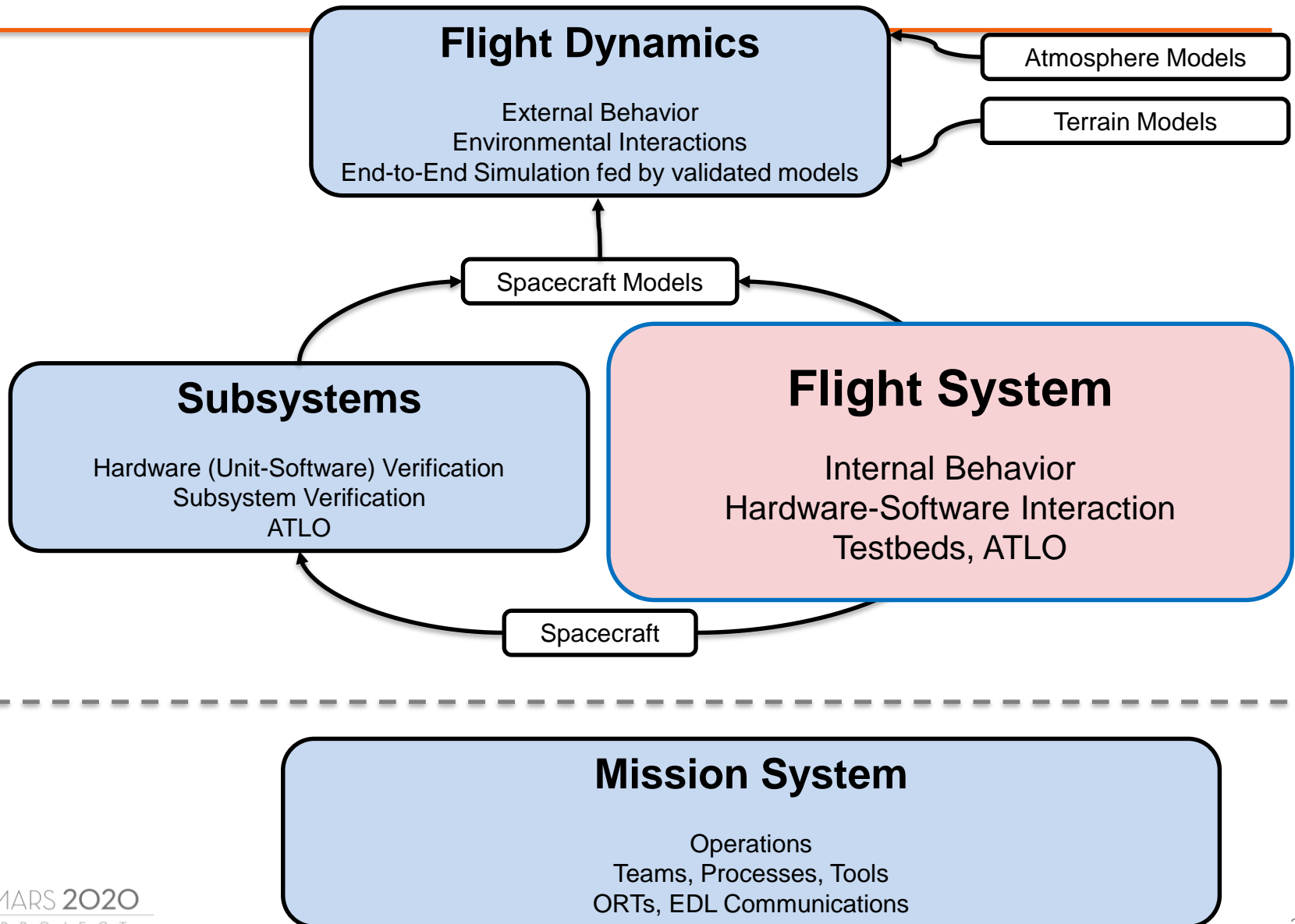
Cj Giovingo
System Engineer

June 12, 2018



MARS 2020
PROJECT

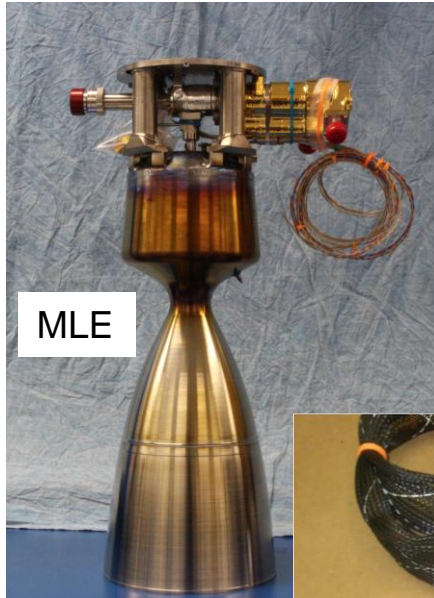
EDL V&V Domains



Flight System V&V

- Based on the heritage MSL V&V program but with some added challenges
 - Smaller team to accomplish the testing
 - Must complete our V&V before Launch so as not to interfere with Surface behavior testing
 - In addition, we must share our testbed venues with the Surface team to help support the new functions under development
 - New EDL technology added which adds complexities and unknowns to our heritage test program
- To mitigate those challenges
 - Decomposed the system into behavioral functions with dedicated owners to drive the planning and testing
 - Integrated the test plans across the team to create an efficient test campaign within the time and resources we have

Actuators & MEDLI2



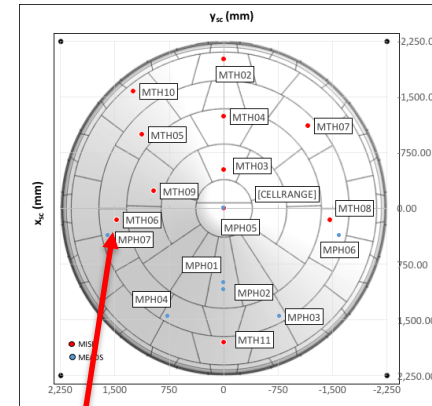
MLE

Actuators

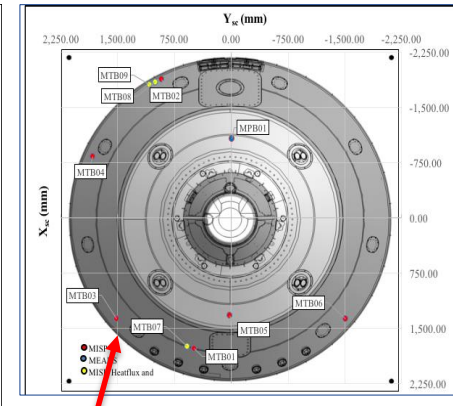
EDL propulsive actuators, specifically the Descent Reaction Control System (DRCS) and Mars Lander Engines (MLE) systems.



RCS Thruster



Heatshield



Backshell



Sensor Plugs

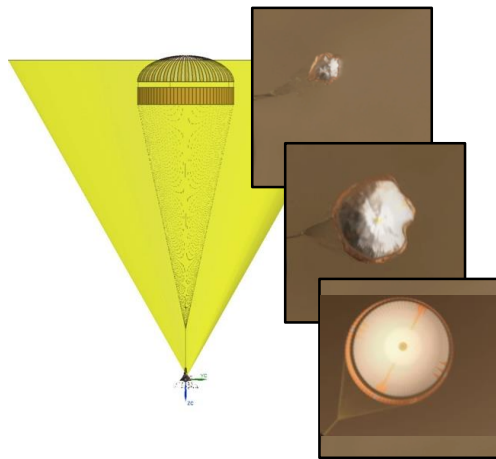


MEDLI2 (Mars EDL Instrumentation 2)
Instrument suite on the heatshield and backshell built upon the heritage MSL MEDLI suite. Analyzes aerothermal, thermal protection and aerodynamic characteristics of the Entry Vehicle during entry and descent into Mars.

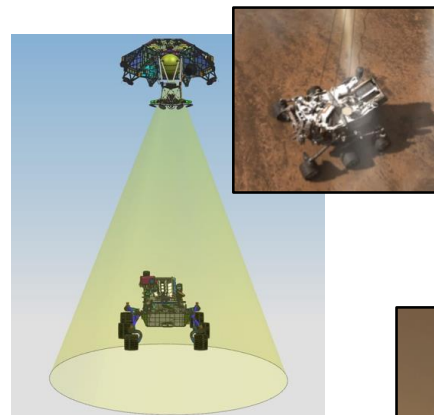
EDL Cameras

New camera suite that captures imagery of key EDL events to aid in reconstruction activities, inform future EDL engineering design activities, and support public outreach activities.

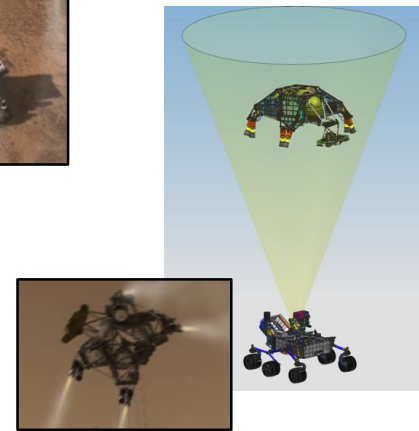
**Parachute Support
Structure Up-look**



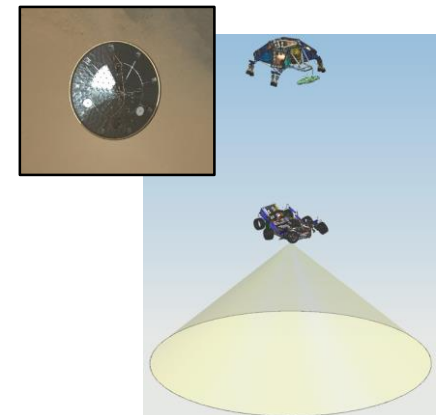
**Descent Stage
Down-look**



**Rover
Up-look**



**Rover
Down-look**



Guidance, Navigation, and Control (GNC) Sensors

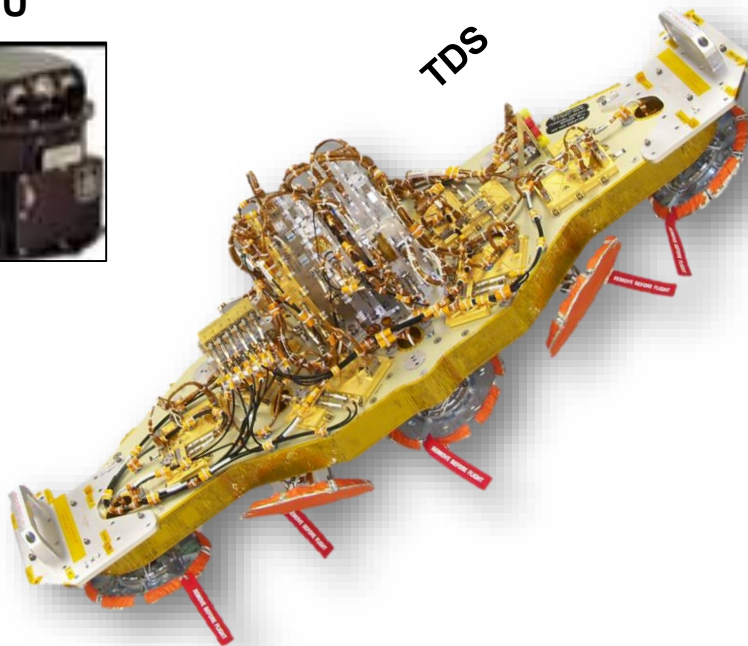
Sensors that provide overall position & rate information throughout EDL, specifically the Terminal Descent Sensor (TDS) and the Descent Stage Inertial Measurement Units (DIMU).

New for Mars 2020, the Terrain Relative Navigation (TRN) with Lander Vision System (LVS), a smart sensor subsystem that provides real-time map-relative position, velocity, and attitude estimates

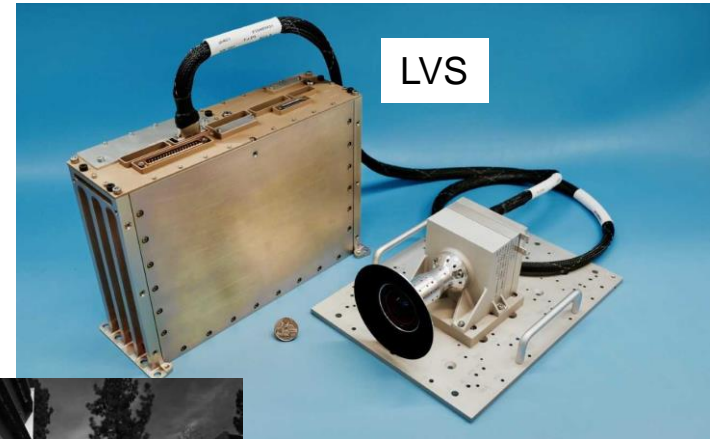
DIMU



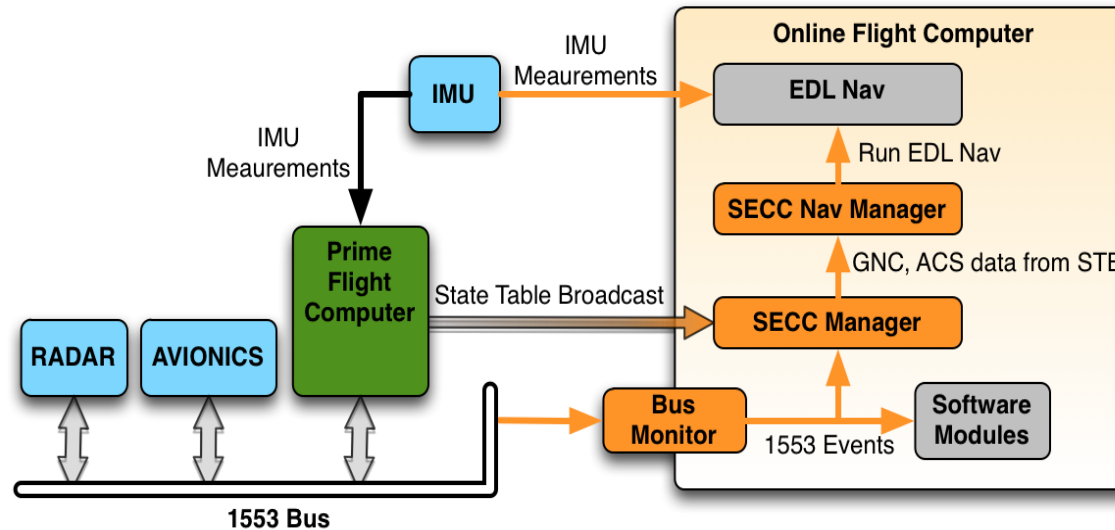
TDS



LVS

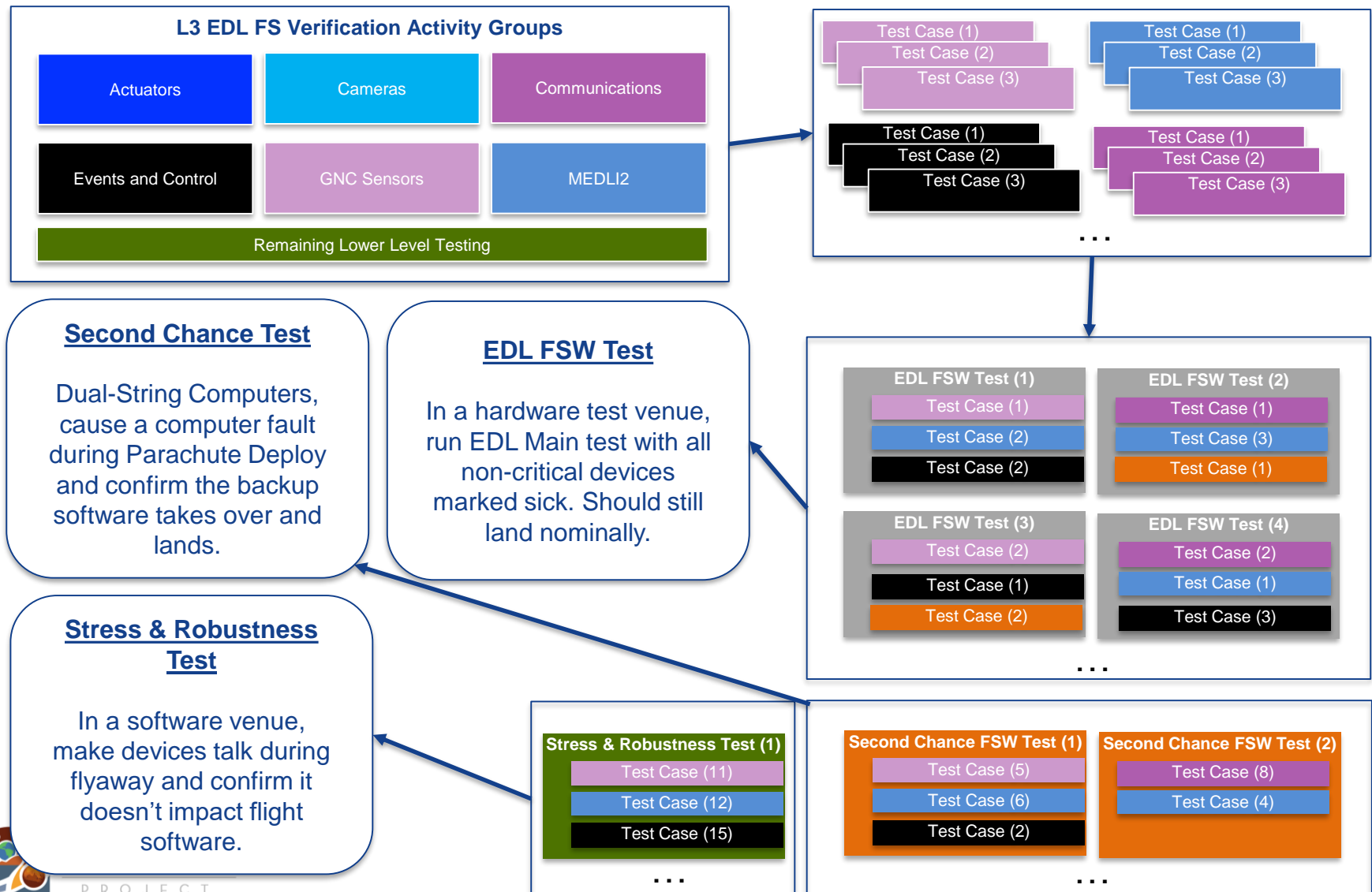


Second Chance (SECC) Flight Software



Back up flight software designed for use only during EDL. Takes control and lands the rover in the event of a fatal on the primary flight software or computer.

Integrated EDL Timeline V&V



Roadmap to Launch

■ To Date

- Inherited the Software and Engineering Hardware Test Venues from MSL
- Updated inherited EDL post-processing scripts which were developed late on MSL
- Conducted development testing on our initial flight software builds

■ Upcoming

- Primary V&V campaign has begun and will be complete by December 2018
- System level tests with flight hardware will begin January 2019 and continue through the end of the year
- Stress and Robustness testing will begin in 2019 and continue until Launch
- Launch in July 2020
- Landing in February 2021